

## Selenium TMDL for Salt Slough

### Summary of TMDL Action

TMDL (Loading Capacity)	2 ppb Selenium as a monthly mean
<b>Load Allocation</b> Subsurface Drainage from the Drainage Problem Area	2 ppb Selenium as a monthly mean
<b>Waste Load Allocation</b> (no NPDES sources)	0 lbs Selenium

### Problem Description

Salt Slough is listed in accordance with Section 303(d) of the Clean Water Act for exceeding selenium water quality objectives. It is one of the principal drainage arteries for the Grassland Watershed in the Western portion of the San Joaquin River Basin (Attachment 1). The soils in the watershed are derived from the marine sediments of the Coast Range, which are high in salts and selenium. Major land uses in the watershed include agriculture and wildlife refuge wetlands. There are no NPDES permitted sources that discharge to Salt Slough.

Dry conditions make irrigation necessary for nearly all crops grown commercially in the watershed. Irrigation of soils derived from marine sediments leaches selenium into the shallow groundwater. Subsurface drainage is produced when farmers drain the salty groundwater from the root zone to protect their crops, and a portion of the Grassland Watershed that generates subsurface drainage has been designated as the Drainage Project Area (DPA). The discharge of subsurface drainage from that area resulted in violations of selenium water quality objectives in Salt Slough and other water bodies within the watershed and downstream. Selenium is a bioaccumulative trace element that, under certain conditions, can be mobilized through the food chain and cause both acute and chronic toxicity to fish and wildlife. Deformities and deaths of aquatic birds have been linked to toxic concentrations of selenium.

Salt Slough discharges to the San Joaquin River upstream of the Merced River inflow near the northern boundary of the Grassland Watershed. Salt Slough has undergone dramatic changes in hydrology and water quality due to agricultural and wetland development. Prior to September 1996, subsurface drainage from the DPA flowed through the Grassland wetlands and Salt Slough on its way to the San Joaquin River (Attachment 2). There was concern that the elevated selenium concentrations in the subsurface drainage would cause problems for the aquatic birds and wildlife that utilize the Grassland wetlands. Salt Slough was placed on the Clean Water Act Section 303(d) list in 1990 for exceeding the selenium water quality objective established to protect waterfowl and other wildlife uses.

The Clean Water Act mandates that States establish Total Maximum Daily Loads (TMDL) for water bodies on the Section 303(d) list. The remaining sections of this

report describe the required TMDL elements developed for Salt Slough by the California Regional Water Quality Control Board, Central Valley Region (Regional Board).

### **Numeric Target**

In 1996, the Regional Board adopted an amendment to the Water Quality Control Plan for the San Joaquin River Basin (Basin Plan) for the Regulation of Agricultural Subsurface Drainage. The amendment contained a selenium water quality objective for wetland water supply channels and Salt Slough. This objective, which was approved by the State Board and the Office of Administrative Law, is a monthly mean concentration of 2 ppb. It was made more stringent than the selenium objective for other water bodies to offer added protection to the waterfowl using the wetlands. Based on a review of the available scientific literature, the Regional Board determined that a 2 ppb monthly mean selenium objective would be protective of waterfowl (California Regional Water Quality Control Board, Central Valley Region; 1996; pg. 61).

Consideration was given to translating the selenium water quality objective into a load limit, but water quality data collected in Salt Slough in the late 1980's through early 1990's showed little change in concentration even in response to significant load reductions (California Regional Water Quality Control Board, Central Valley Region; 1995; pp. 5-7). Based on this information, the Regional Board concluded that removal of untreated subsurface agricultural drainage was required to meet water quality objectives (California Regional Water Quality Control Board, Central Valley Region; 1996; pp. 67-68). Therefore, a concentration-based objective was determined to be the best measure of success at protecting beneficial uses and achieving water quality improvements. The numeric target for the Salt Slough TMDL is the adopted Basin Plan selenium water quality objective of a monthly mean of 2 ppb.

### **Source Analysis**

Although selenium exists naturally in the soils of this watershed, some land use practices accelerate its movement to ground and surface waters. The major components of the historical flow in Salt Slough are subsurface and surface drainage from the DPA and wetlands discharge. Subsurface drainage, specifically from the tile drains in the DPA, is the most significant source of selenium to Salt Slough. Selenium concentrations in tile drainage ranged from 25 to 500 ppb, far above that for the other two components of flow in the Slough. The Regional Board has conducted over a decade of water quality sampling at a site on Salt Slough upstream of historical inputs from the DPA. This site represents background contributions to Salt Slough (i.e. including wetland drainage flows and agricultural return flows outside of the DPA). The median value of selenium was 0.9 ppb and the mean was 1.1 ppb for over 200 samples collected (California Regional Water Quality Control Board, Central Valley Region; February, 1998; pg. 171). Recent data also shows (attachment 4) that in the absence of agricultural subsurface drainage water from the DPA, concentrations in Salt Slough are less than 2 ppb. This data confirms that "background" sources of selenium in Salt Slough are not significant.

**Implementation Plan**

In 1996, the Regional Board amended its Basin Plan for control of agricultural subsurface drainage discharges. This Basin Plan Amendment prohibits discharge of subsurface drainage water to Salt Slough and the Grassland wetlands if it results in concentrations exceeding the water quality objective, and therefore eliminates the largest loading of selenium to Salt Slough. Since September 1996, tile drainage from the DPA has been rerouted through the Grasslands Bypass Structure, which is a portion of the former San Luis Drain and away from the Grassland wetlands on its way to the San Joaquin River (Attachment 3).

The other sources of water to Salt Slough are the wetlands discharge, surface drainage and groundwater accretions. The selenium concentrations of those sources are commonly less than 2 ppb, as discussed above; therefore, no implementation provisions are necessary to ensure sources, other than agricultural subsurface drainage from the DPA, remain below the numeric target.

**Allocations**

Subsurface drainage is prohibited from discharge into Salt Slough if it results in concentrations exceeding the water quality objective; therefore, the subsurface drainage allocation is expressed as the water quality concentration of 2 ppb as a monthly mean. As discussed in the "Source Analysis" section above, load allocations for the surface drainage, wetlands discharge and groundwater accretions are not necessary since they are not significant sources and are consistently found to be less than 2 ppb.

**Performance Measures & Feedback**

Monitoring conducted since the use of the Grasslands Bypass Project was initiated indicates that the diversion of the tile drainage away from the Grassland wetlands and Salt Slough has enabled Salt Slough to attain the selenium water quality objective except during the recent El Nino storm events (Attachment 4). In January 1997, there was one sample with a selenium concentration above 2 ppb, but the monthly mean water quality objective was met. During the El Nino storms in February and March of 1998, the water quality objective was exceeded. During this period, the San Luis Delta-Mendota Water Authority was not able to contain the flood flows and violated the Basin Plan by discharging subsurface drainage into the Grassland wetlands. The Water Authority through development of a stormwater management plan has addressed these violations of the Basin Plan.

The Regional Board has monitored selenium levels in waters of the Grassland Watershed since 1985. One monitoring station is located in Salt Slough at Lander Avenue. Water quality data including selenium concentration is collected weekly at this station. Monitoring reports are published monthly and available on the Internet for public review as part of the Grassland Bypass Project ([www.mp.usbr.gov/mp400/irrdn/grasslnd](http://www.mp.usbr.gov/mp400/irrdn/grasslnd)).

Regional Board staff will review the monitoring data and consider revising the TMDL or taking other appropriate action if the numeric target is not met.

### **Margin of Safety and Seasonal Variation**

The Clean Water Act requires that a margin of safety be included with TMDL development. This TMDL incorporates a margin of safety by prohibiting the discharge of subsurface drainage into Salt Slough if it results in selenium concentrations exceeding the water quality objective. The removal of agricultural subsurface drainage from Salt Slough (see discussion in Performance Measures and Feedback) provides the necessary margin of safety to ensure that the numeric target is consistently met. In addition, the removal of agricultural subsurface drainage originating from the DPA should result in average conditions in Salt Slough that are well below the numeric target (see discussion under Source Analysis).

Prior to the 1996 amendments to the Basin Plan, wetland water supplies had generally been protected seasonally during the fall flood-up. The availability of more water for wetland uses meant that such limited, seasonal protection was no longer protective of beneficial uses (California Regional Water Quality Control Board, Central Valley Region; 1996; pp. 9-11). Since waterfowl are most sensitive to selenium and wetland water supplies may now be delivered from Salt Slough to wildlife refuges at any time during the year, there is no seasonal adjustment in the numeric target (which is the water quality objective).

### **Public Participation**

The Regional Board held workshops and public hearings for the 1996 Basin Plan Amendments for the Control of Agricultural Subsurface Drainage Discharges. The State Board also held approval hearings. The adoption of the Basin Plan Amendment in 1996 enabled the implementation of the Salt Slough TMDL; therefore, the public hearings held for the Amendment fulfill the public participation requirements of this TMDL. The administrative record for the workshops and public hearings held for the Amendment are on file at the Regional Board in five 3.5-inch binders. The index for the administrative record is included as Attachment 5. The letters received during the comment periods are included as Attachment 6; the responses to the letters and the comments made during the workshops are included as Attachment 7.

This TMDL will be incorporated into the Regional Board's Water Quality Control Plan during the next Basin Plan Update, and Salt Slough will be taken off the Section 303(d) list during the next Section 303(d) update following incorporation of the TMDL into the Basin Plan.



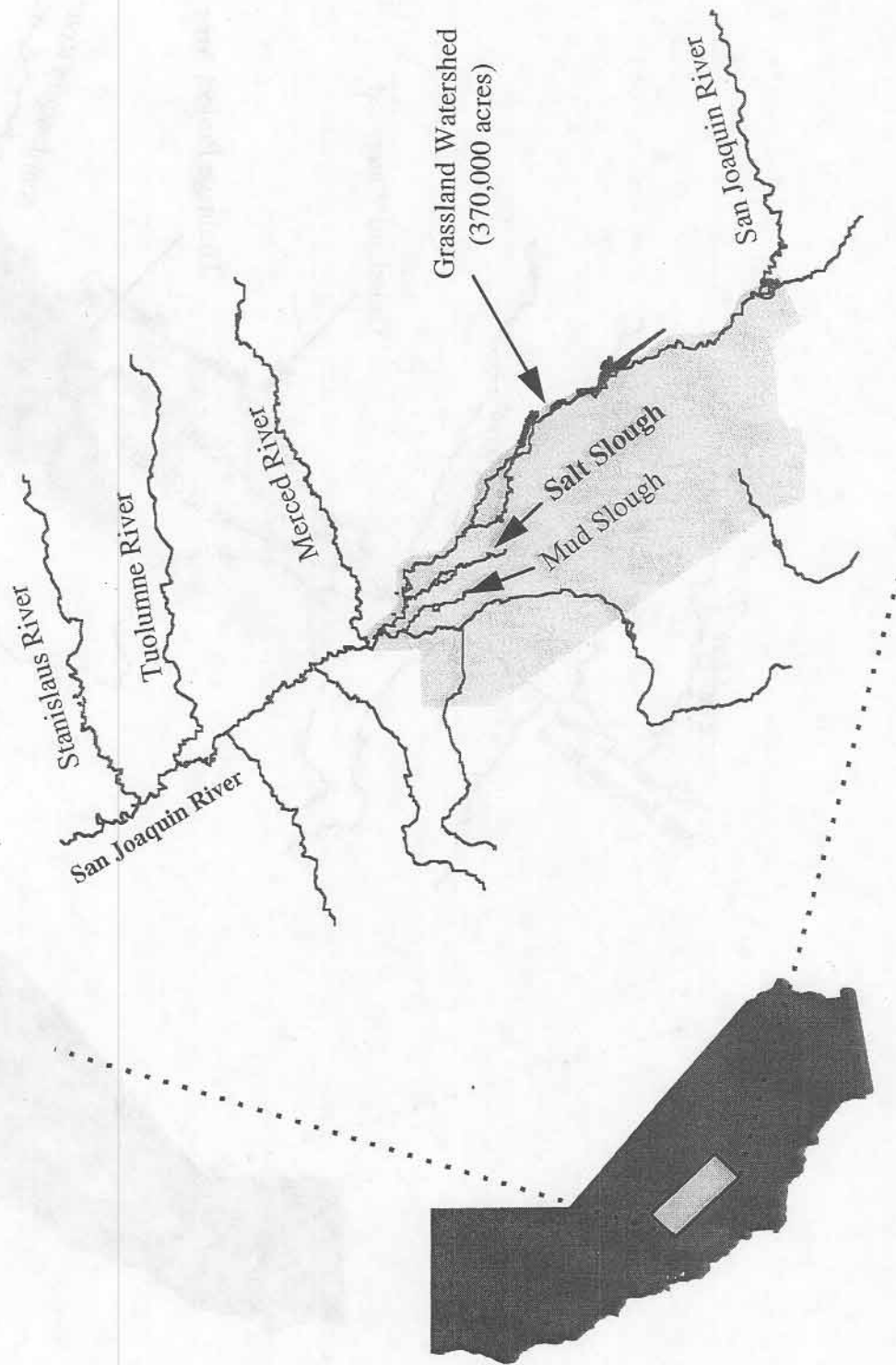
**References**

California Regional Water Quality Control Board, Central Valley Region; 1995. *Staff Report on the Beneficial Uses Designations and Water Quality Criteria to be Use(d) for the Regulation of Agricultural Subsurface Drainage Discharges in the San Joaquin Basin (5c)*; June, 1995.

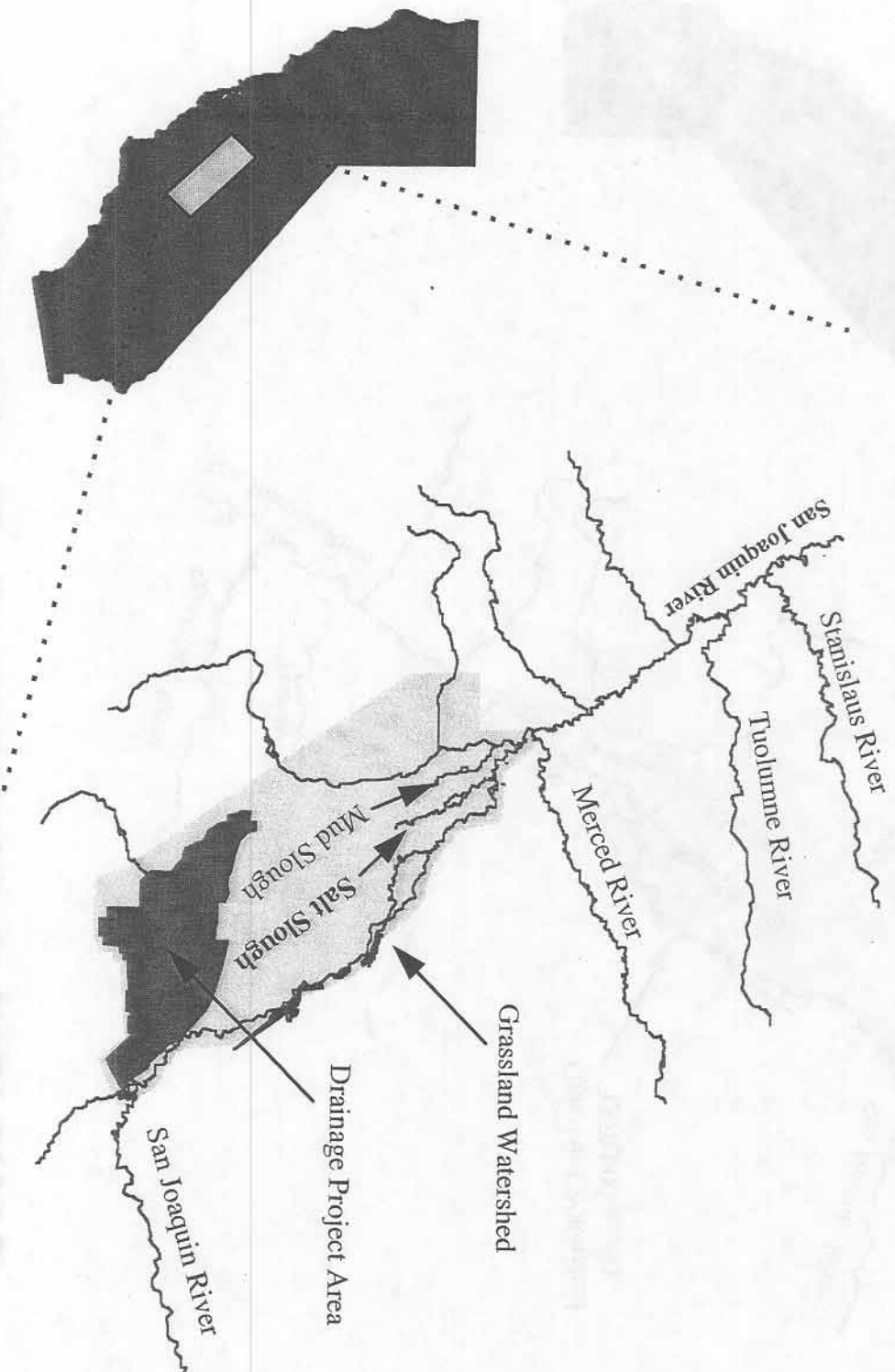
California Regional Water Quality Control Board, Central Valley Region; 1996; *Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Agricultural Subsurface Drainage Discharges*; Staff Report; March, 1996.

California Regional Water Quality Control Board, Central Valley Region; 1998; *Compilation of Electrical Conductivity, Boron, and Selenium Water Quality Data for the Grassland Watershed and San Joaquin River; May 1985-September 1995*; February, 1998.

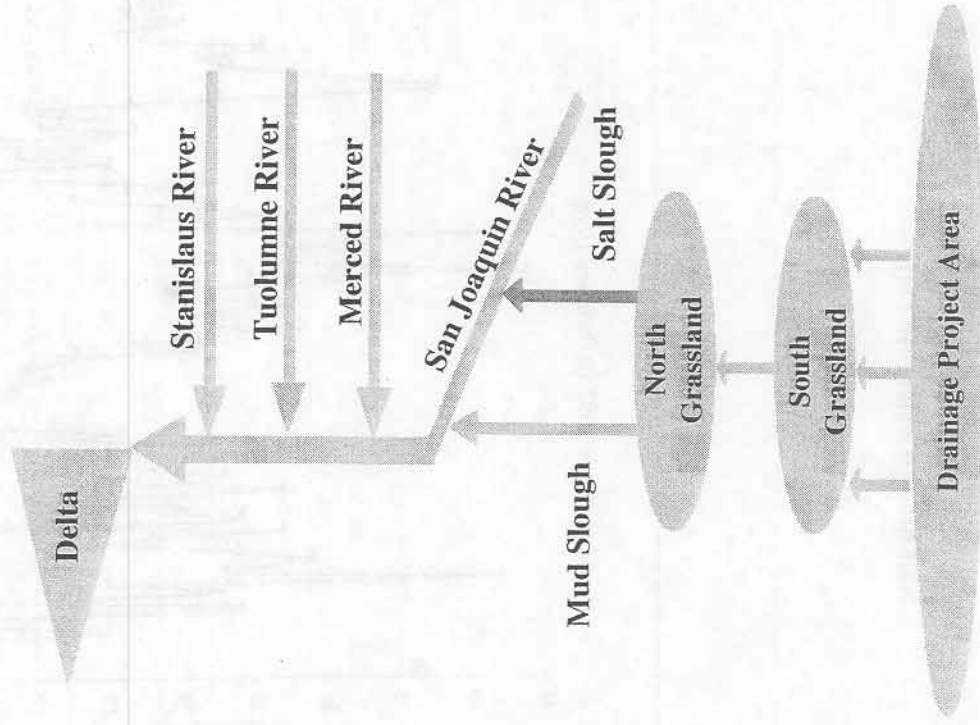
# Attachment 1: Grassland Watershed



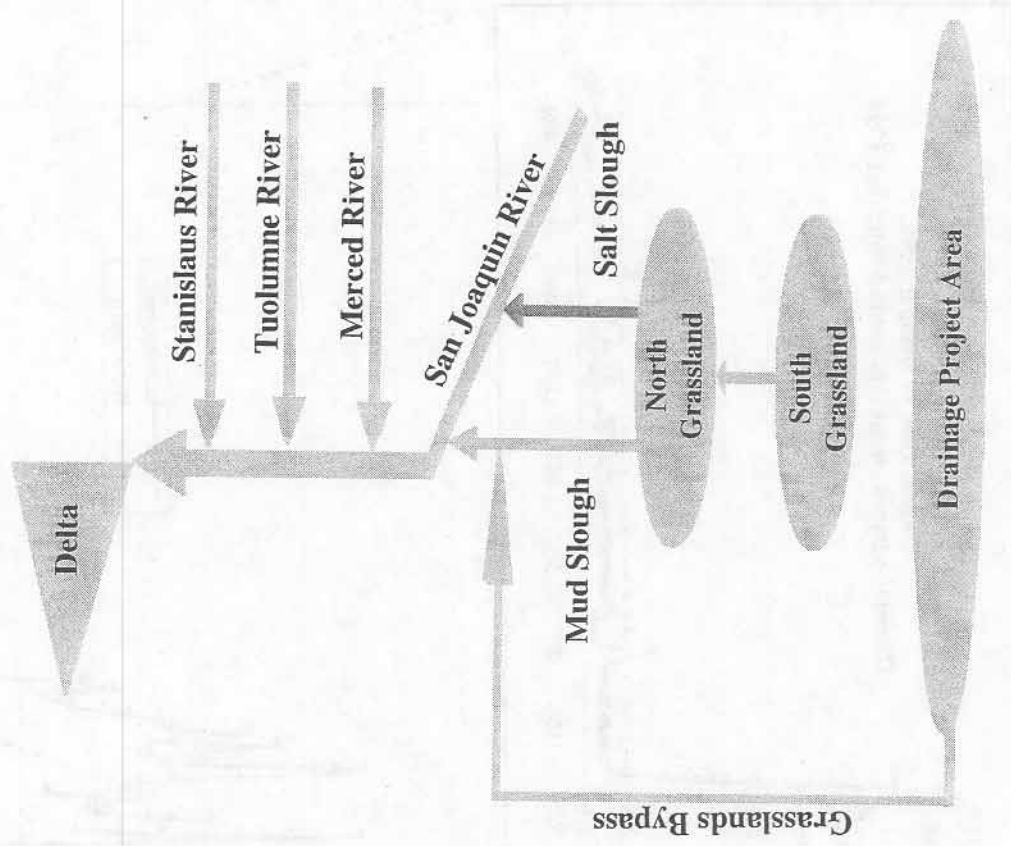
# Attachment 2: Drainage Project Area



### Attachment 3: Use of Grasslands Bypass to Divert Subsurface Drainage



Before September 1996

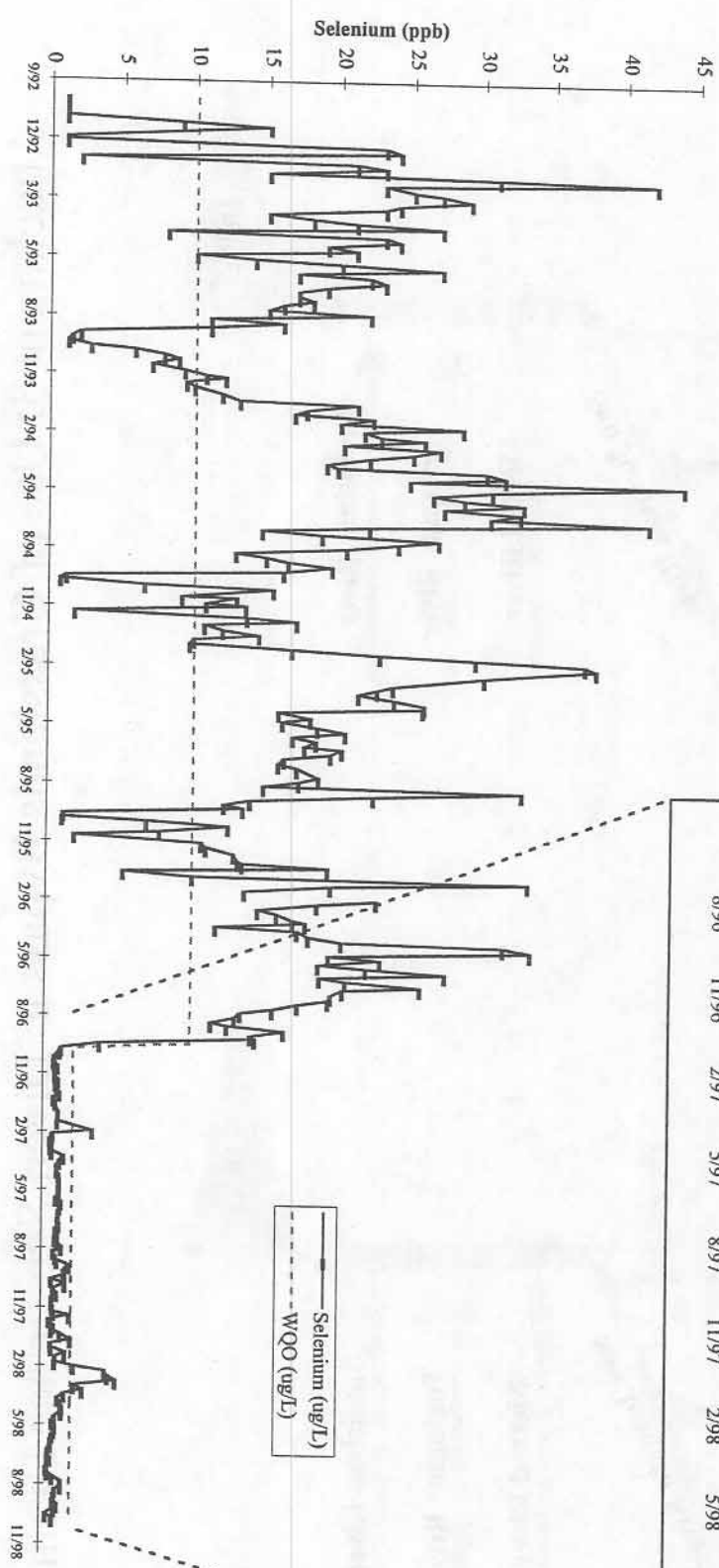


After September 1996

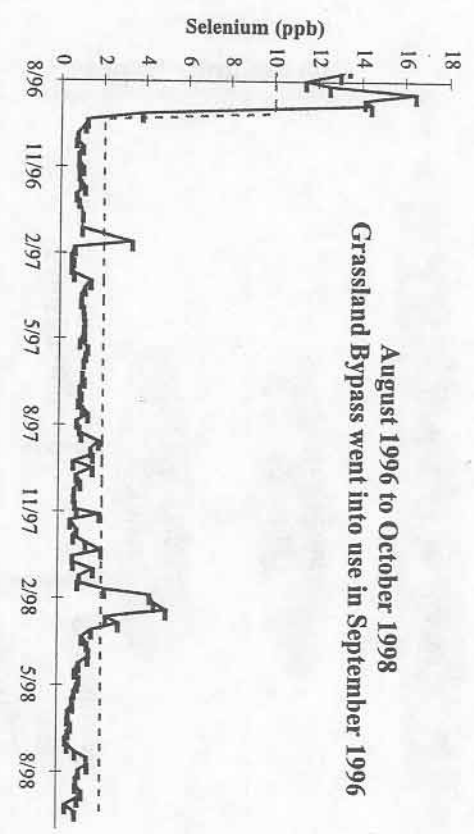


# Attachment 4 Salt Slough Selenium Data

October 1992 to October 1998



August 1996 to October 1998  
Grassland Bypass went into use in September 1996



**Attachment Note**

Attachments 5 through 7 are available upon request. Please contact Jennifer Heyd at (916) 464 – 4735 or at [jheyd@waterboards.ca.gov](mailto:jheyd@waterboards.ca.gov) to request copies.